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AFFORESTATION OF THE UPPER DON SANDS

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The Stalin Plan for the Transformation of Nature in the steppe and forest steppe regions of European USSR calls for extensive sand afforestation work. In Voronezh Oblast alone, 37,000 hectares must be afforested during the period 1949-1965. The forested area in Voronezh Oblast can be increased as much as three to four times if up to 50 percent of the sand expanses are covered with narrow 20- to 30-meter-wide field shelter belts and up to 100-meter-wide connecting tree plantings.

As is known, the upper Don sands represent old alluvial terrace formations. The terraces have for the most part been worn down by subsequent erosion processes and can now be distinguished only with difficulty. Above the city of Liski the sands form a gigantic crest which rises up to 100 meters above the level of the Don River and gradually merges with the clay loam chernozem steppe. The steppe is broken in places by ravines and frequently resembles the central part of a flood plain. Under the clay loam lies a layer of quaternary sand up to 120 meters thick. In the direction of the present-day flood plain of the Don, the clay loams diminish and sands rise to the surface. Ground water is usually found at great depths (40-100 meters) and is only found at a higher level in a few places where impervious clay loam layers are present.

The sands nearest the flood plain have crests 4 to 6 meters high. Farther away, the terrain becomes rolling. Where the sands begin to merge with the clay loam steppe, flat sandy loam belts 2 to 8 kilometers wide are distinguishable. These belts are set off from the flat clay loam steppe by a low terrace 2 to 4 meters high.

Dune sands, so typical of the middle and lower Don, seldom occur in Voronezh Oblast. They occupy only a small area of several thousand hectares in the southern part of the oblast around the villages of Bereznyagi, Zamost'ye, and Gadyachiy.

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Three types of sand can be distinguished, each characterized by a special combination of natural conditions: dune sands, crested light sandy loams, and flat moderately heavy and heavy sandy loams.

Dune sands are old aeolian accumulations covered with fescue (Festuca sulcata)-feather grass (Stipa) vegetation growing on friable sandy soils called gray sands. A distinctive characteristic of these soils is the pale (grayish-yellowish) color of the horizons. The humic horizon, 20 to 25 centimeters thick, and the horizon transitional to the mother rock are composed of light yellow old wind-blown sand and exhibit a total lack of compact cemented horizons and layers. Humus content in these horizons does not exceed 0.25 to 0.3 percent, and clay (particles less than 0.01 millimeter in diameter) content is not greater than 4 to 5 percent. The maximum field capacity of moisture of these soils is very low (3 to 4 percent) and the wilting percentage is about 0.6 percent. When moisture content drops below 1.2 to 1.5 percent, the sand is dry to the touch. Gray sand soils are thoroughly soaked through each spring, but during the summer they dry out to a depth of 1.0 to 1.5 meters. Only heavy rains are able to soak these soils to a depth of 30 to 50 centimeters. By November the soils are usually again moist to the touch.

Gray sand areas where ground water is found at a level deeper than 1.5 to 2 meters are little suited to tree growing. Plowing up these sands can lead to blowing and covering up of adjacent fields with sand. It is possible to plow in narrow strips 20 to 30 meters wide, leaving strips of virgin soil between these strips, and planting the narrow strips with wind-breaking smoke trees (Continus Coggygria), sorghum, rye, etc. But it is wiser at present to use the greater part of the sands with ground water at a deep level for controlled grazing purposes and to use for pine (Pinus) planting and for vegetable and berry growing only the lowland where ground water is found above the 1.25-meter level, occupied by birch (Betula)-aspen (Populus tremula) clumps on meadow and meadow bog soils.

The greater part of the gray sand area, however, was subjected to overgrazing by cattle between 1860 and 1890 and was changed into a secondary dune sand area which is almost bare or covered with sparse psammophytic vegetation and with the remains of half-covered tree clumps. Such sands do not dry out to a depth greater than 10 to 15 centimeters during the summer, but their field capacity of moisture is so low (3 percent) that they are unable to store water. This quality of the sands together with their mobility does not tend toward a high rate of survival or growth of trees on the tops or sides of the dunes. On the other hand, the low-lying area between dunes which has ground water at a level not deeper than 1.25 to 1.5 meters can be afforested (mostly with pine). About 40 to 50 percent of the dune sands could be covered with clump-like plantings.

About 60 percent of the old river terrace area along the left bank of the Don is composed of crested lowland, sloping toward the Don and covered with light brown, light sandy loam soils. A peculiar feature of these soils is that at a depth of 1 to 1.5 meters they are mottled with zebra-like striped formations which may have resulted from the degradation of the overlying reddish, colloidal iron, illuvial horizon, which is usually poorly expressed in these light sandy loam soils. Above the secondary horizon lies the 50- to 80-centimeter-thick upper horizon composed of humic, coarse, gravelly, light sandy loam (containing up to 20 percent coarse sand) which has a grayish-brownish color. Downward, the color lightens to whitish.

Typical vegetation found on virgin, light brown, coarse, gravelly, light sandy loams is fescue-feather grass with occurrences of Cleistogenes (Diplochne) squarrose.

Humus content in these soils is as great as 5 to 8 percent; clay particle content is 8 to 12 percent in the upper horizon, up to 20 percent in the lower horizon. Maximum field capacity of moisture is as great as 6 to 7 percent in the upper horizon, 10 to 12 percent in the lower horizon. Corresponding wilting percentages in the upper and lower horizons are 1 to 1.3 percent and 3 to 4 percent, respectively. During the summer these soils dry out to a depth of 1.5 meters under steppe vegetation, but are thoroughly soaked in the spring and sometimes even accumulate small quantities of surface water in low-lying places. But ground water for the most part lies very deep.

V. A. Dubyanskiy and other students of Don sands make no distinction between these soils and group them all into either gray sands or chernozem-like sandy loams. But the extensive occurrence of these soils along the upper, middle, and lower Don and their peculiar tree-growing qualities require that they be studied carefully. They are little suited for agricultural purposes. In earlier times, the usual practice was to grow melons or rye on them for one or 2 years and then to let the land lie fallow to be overgrown with weeds. As a result, 10 to 15 percent of this area has become a shifting sand area with unstable soils and many hollows. But the presence of aeolian depositions improves retention of precipitated moisture, and the good moisture capacity of the low-lying humic and illuvial horizons permits spring storage of moisture almost 1.5 to 2 times greater than in loose sands and gray sands.

When carried out on well-prepared soil (ground plowed 25 centimeters deep on which melons had been grown previously), pine growing is possible everywhere on light brown sandy loams, regardless of the depth of occurrence of ground water. These soils are the ones along the Don which should be afforested first. Along the lower Don, pines growing on several thousand hectares of these soils are already 40 to 70 years old.

In 1932, the Bogucharskiy Experimental Point (near the settlement of Staro-Tolucheyevo) of the Voronezh Forestry Experimental Station was set up to work on these light sandy loams. Field shelter belts and industrial crop plantations have been planted there, rates of growth and root system development have been studied, etc.

About 35 to 40 percent of the upper Don area is covered with chernozem-like sandy loams or, as they are also called, dark brown, deeply humic sandy loams under fescue-feather grass-steppe grass vegetation with occasional small oak clumps or groves. As stated above, these belts of sandy loams border on the clay loam chernozem steppe.

In the steppe variant of these soils, the 1- to 1.5-meter-thick, dark, humic, sandy loam horizon merges with a 0.2- to 0.4-meter-thick reddish brown illuvial horizon which, farther down, gradually changes into light yellow sand. The sand is frequently underlain at a depth of 4 to 5 meters by yellowish brown steppe clay loam. The forest variant of these soils exhibits definite traces of recent degradation.

The humus content in dark brown sandy loams is as great as 1 to 1.8 percent (very exceptionally higher); content of "melkozem" (soil particles less than 0.01 millimeter in diameter) varies between 10 to 13 percent in the upper horizon, 15 and 20 percent in the lower horizon. Maximum field capacity of moisture is 10 percent in the upper horizon, 10 to 12 percent in the lower horizon. Wilting percentage is 2 to 3 percent in the upper horizon, 4 to 6 percent in the lower horizon. These soils are thoroughly soaked each spring, with or without resultant surface water accumulation. A large part of the spring moisture accumulates in the upper and lower horizons. Under luxurious steppe vegetation, these soils dry our during the summer to a depth of 1.5 to 1.7 meters.

Dark colored sandy loams are satisfactorily being used for agricultural crops and in dry years produce better harvests than do the neighboring clay loam chernozems. But as a result of excessive plowing up of these soils, 10 to 15 percent of this dark brown, sandy loam area has become badly eroded. The eroded area can be used for planting of pine, oak, and birch, and in the future the rest of the area can be used for agricultural crops. Crops must be protected by a system of shelter belts. Primary belts may be 250 meters apart, while secondary belts may be 750 to 1,000 meters apart.

Altogether, up to 100,000 hectares of the Don River sands in Voronezh Oblast can be afforested. The light brown, light sandy loams are the soils most suited for pine planting. All forestry work can be mechanized where these soils occur.

It should be emphasized that afforestation of the Don sands can be carried out without danger of lowering the ground water level because the level already is very deep (40-80 meters) and also because the moisture requirement of trees will not exceed that of the steppe vegetation now growing on these soils. It is also to be expected that ground water supply will be improved by the system of shelter belts and forests just as it was when the Kamennaya Steppe was afforested.

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